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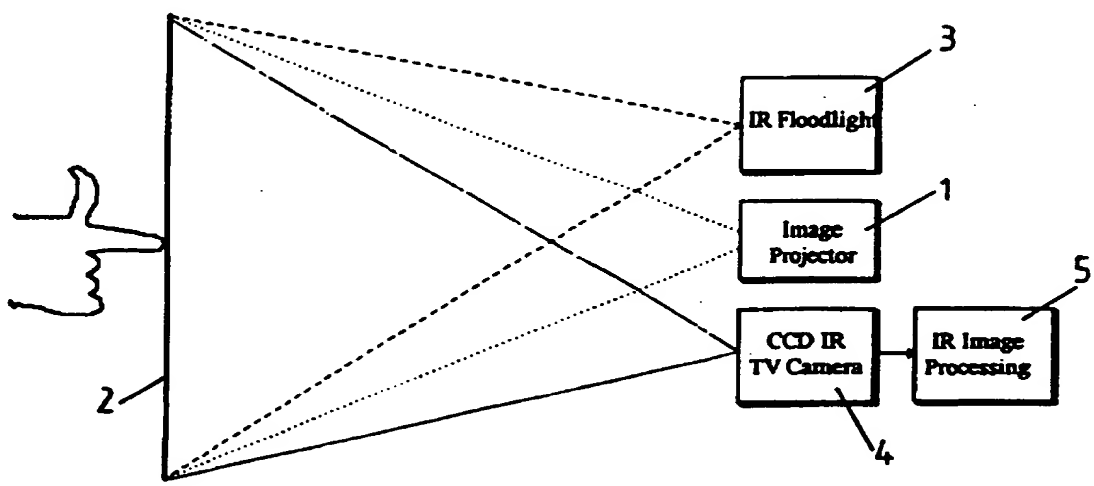

(57) Abstract

A system for determining the point of contact of an object with a first side of an at least partially transparent screen (2), the system comprising a radiation source (3) for illuminating the opposite side of the screen to said first side, at least one radiation detecting means (4) for monitoring the radiation reflected from the screen and from any object placed in contact with said first side f the screen, and for producing a signal representative of the monitored image, and signal processing means (5) f r processing the signal representative of the monitored image to determine the screen co-ordinates of the or each point f contact of an object with the screen.

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A METHOD AND SYSTEM FOR DETERMINING THE POINT OF CONTACT OF AN OBJECT WITH A SCREEN

The present invention relates to a method and system for determining the point of contact of an object with a screen. Particularly, but not exclusively, the invention relates to a touch sensitive data input system.

There exist many different mechanisms for inputting data to computer based systems, such as keyboards, "mouse" devices, trackballs, joy sticks and touch sensitive devices. Known touch sensitive input devices, generally referred to as "touchscreens", are based on a variety of different technologies, the most common of which are discussed below. In all cases, a touch sensitive screen assembly is used in conjunction with the system display device, the location of a touch (by finger or other object) on the screen indicating the data to be input to the system.

One common form of known touchscreen device utilises capacititive overlay technology. In such devices the display unit is provided with a glass overlay screen which is coated with a thin transparent conductor layer and the finger (or other object used to touch the screen) capacitance is sensed to determine the touch location (and thus the input data). That is, touching the overlay screen with a finger produces a capacititive coupling with the conductive layer, resulting in current flow to the finger. The current flow to the finger from each corner of the screen is proportional to the distance from each corner to the point of contact of the finger with the screen. The screen co-ordinates of the point of contact can thus be obtained by measuring the ratios of the currents at each corner of the screen.

Capacititive overlay devices are capable of high resolution but suffer from drift and thus require periodic calibration. In addition, the conductive layer reduces the transmissivity of the screen to around 85% to 90%. Furthermore, a conductive stylus is required to touch the screen and thus the device would not necessarily work when touched with a gloved finger. A further disadvantage of

capacititive overlay devices is that they are not capable f discriminating between two separate but simultaneous touches (in such circumstances the average of the two touch positions will be calculated).

In another known type of touchscreen device, known as "force vector" devices, the display device is mounted on a base which measures force applied to the device (by touching the device with a finger or other object) in three degrees of freedom. The measured components of the applied force can be resolved to determine the location at which the force is applied to the screen. Such devices cannot, however, achieve particularly high resolution and are unable to discriminate between simultaneous forces applied at more than one location. In addition, calibration of this type of device is complex and time consuming and periodic checks are necessary.

In an alternative device, a rigid glass screen is mounted at each corner via strain gauges (for example piezoelectric transducers). Touching the screen at any given location will cause different forces to be measured at each of the strain gauges from which the location of the touch can be determined using a suitable algorithm. Although high resolution can be achieved with such devices, calibration is complex and time consuming and, since drift is a problem, periodic calibration is required. Moreover, as with the above touchscreens, devices of this type cannot discriminate between more than one touch location.

There are also known touchscreens which utilise resistive overlay technology. Such devices essentially comprise an overlay screen of sandwich construction having a rigid glass backing sheet separated from a top flexible plastics (for example polyester) cover sheet by spaced insulators. Both the glass backing sheet and plastics cover sheet are coated with a thin transparent metallic layer such that the two layers face each other (being separated by the insulators). The arrangement is such that touching the cover sheet presses the two metallic layers together to form a conductive path at the point of contact. With a voltage applied acr ss the two metallic layers, the ratio f the resistances fr m the point of c ntact to the top and bottom edges and each side edge of the screen can be

calculated to determine the location of the point of contact. Such devices offer high resolution but have the disadvantage that the overlay structure is relatively complicated. In addition, the transmissivity of such devices can only be expected to be in the region of 50% and 75%, and reflection and glare can be a problem. Resistive overlay devices also suffer from drift as a result of which periodic calibration is required. Furthermore, resistance overlay devices are not suited to discriminating multiple contact points.

Other examples of known touch screens utilise acoustic wave technology. In one such type of device, known as a guided wave device, acoustic waves are transmitted through a glass sheet from edge to edge using edge mounted transmitters and receivers. Touching the sheet at any particular location results in localised attenuation of the acoustic signal. This attenuation can be detected and used to compute the touch position. However, the transmissivity of such devices is only about 90% and they suffer the additional potential disadvantage that a soft, energy absorbent, stylus (such as a finger) must be used. Again, with such devices it is difficult to discriminate multiple touch points.

As a variation of the above guided acoustic wave devices, devices exist in which acoustic waves are transmitted across the surface of a glass screen as opposed to through the screen. Such devices have similar disadvantages to guided acoustic wave devices and provide lower resolution.

Finally, scanning infra-red devices are known, which comprise multiple infra-red emitters and detectors located along the top and bottom and each side respectively of the screen. The emitters are pulsed sequentially to form an invisible grid overlaying the screen so that touching the screen interrupts one or more infra-red beams from which the location of the touch can be determined. Such devices suffer from the disadvantage that emitters and detectors have to be arranged along the edges of the display and that resolution is limited to the number of emitters and detectors provided. Parallax can also be a problem since the infra-red beams are displaced from the surface of the screen. With such devices it is difficult to determine between two separate t uch points, unless the

touch points are clearly separated in both the x and y directions (close proximity in either x or y direction can result in an ambiguous readout).

It is an object of the present invention to obviate or mitigate at least some of the disadvantages discussed above.

According to a first aspect of the present invention there is provided a method for determining the location of the or each point of contact of one or more objects with a first side of an at least partially transparent screen, the method comprising:

(i) illuminating the opposite side of the screen to said first side with radiation;

(ii) monitoring the radiation reflected from the screen and from any object placed in contact with said first side of the screen and producing a signal representative of the monitored image; and

(iii) processing said monitored image signal to determine the screen co-ordinates of the or each point of contact of an object with the screen.

The term "radiation" is used above (and hereinafter) in a general sense to cover any radiation for which the screen is at least partially transparent and which may be reflected by a suitable object contacting said first side of the screen. It is, however, preferred that infra-red radiation having a frequency of the order of 4×10^{14}Hz to 3×10^{11}Hz is used.

The present invention thus provides a method for determining the location at which a screen is touched which offers a number of potential advantages over the prior art discussed above, when used as part of a data inputting system. For instance, using conventional image processing methods and hardware, it is relatively straightforward to discriminate between multiple simultaneous points of contact with the screen. In addition, the method is not limited to detection of certain types of object (eg conductive or energy absorbent styluses as in the case of some of the prior art devices discussed above) and thus can be used to detect touching of the screen by any object, including a finger (gl ved r therwise).

A further advantage of the above method is that it does not require a screen of complex construction. For instance, the method is particularly suited for use in conjunction with a back projection visual display system in which the screen is a simple difusing screen. It will readily be appreciated that because the screen need not be of any special construction, the method is particularly useful for use in conjunction with large screen display systems. A further advantage of the simple screen structure (for instance not requiring conductive coatings etc) is that the screen may have a high transmissivity.

By appropriate choice of the equipment used to monitor the reflected infra-red radiation (for instance one or more television cameras) and image processing (i.e. (step iii) above), the method can provide high resolution.

The central feature of the invention is the use of radiation, and in particular the reflection of radiation from the screen, as a basis for determining the point (or points) at which the screen is touched. The image processing step may vary considerably depending upon the system in which the method is used and the information required.

For instance in a preferred method according to the present invention, the processing step (iii) includes the step of subtracting a representation of the background radiation reflected by the screen from the signal representative of the monitored image to derive a signal representative of localised highlights resulting from contact of the or each object with the screen.

Preferably the processing step (iii) further includes the step of thresholding the signal representative of detected infra-red highlights.

The processing step (iii) may further include performing region of interest calculations to determine both the screen co-ordinates and size of the or each point of contact of an object with the screen, and to discriminate between multiple points of contact.

As touched upon above, the described method may be used in a variety of applications. The method is, however, particularly suited for use with a screen (such as, for example, a diffusing back pr jecti n screen) which is part of a

visual display system and wherein said method forms part of a method for inputting data to the systems processor in response to touching the screen, the data input to the system processor being dependent on the location of the or each point at which the screen is touched.

According to a second aspect of the present invention there is provided a system for determining the point of contact of an object with a first side of an at least partially transparent screen, the system comprising a radiation source for illuminating the opposite side of the screen to said first side, at least one radiation detecting means for monitoring the radiation reflected from the screen and from any object placed in contact with said first side of the screen, and for producing a signal representative of the monitored image, and signal processing means for processing the signal representative of the monitored image to determine the screen co-ordinates of the or each point of contact of an object with the screen.

The signal processor is preferably an image processor which stores a background image of the background radiation reflected from the screen and subtracts this from the monitored image to produce a signal representative of monitored radiation highlights of reflected radiation from the or each object placed in contact with the screen.

The image processor may include thresholding circuitry.

In a preferred embodiment of the invention the image processor includes cluster analysis circuitry which receives a signal from the thresholding circuitry and which produces a signal representative of the screen co-ordinates of the or each point of contact of an object with the screen. The cluster analysis circuitry may be adapted to determine the size of the or each point of contact of an object with the screen. In addition, further processing means may be provided to eliminate from the signal output from the cluster analysis circuitry components representative of points of contact below a minimum size. Similarly, processing means may be pr vided to eliminate from the signal components representative of points of contact ab ve a pre-determined maximum size.

The system is particularly suited for use in conjunction with a screen f a visual display system, such as a back projection system.

According to a third aspect of the present invention there is provided a visual display system, comprising a diffusion back projection screen, and a system for determining the screen co-ordinates of the or each point of contact of an object with the screen as described above.

The system may include an image projector which also functions as the radiation source.

A specific embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic illustration of a visual display and data input system in accordance with the present invention; and

Figure 2 is a block diagram schematically illustrating the image processing steps of the system of Figure 1.

Referring to Figure 1, the schematically illustrated embodiment of the present invention is a back projection display system. The image display part of the system comprises an image projector 1 and a diffusing back projection screen 2. The system is designed so that data can be input into the system by touching the screen 2 (on the opposite side thereof to the projector 1) at one or more appropriate locations. The touch location(s) may, for example, be selected by the user in response to an image of a switch panel projected onto the screen 2 or an interactive game display.

To enable the screen co-ordinates of the touch location(s) to be determined, the system includes an infra-red radiation floodlight 3 which illuminates the back of the screen 2 with infra-red radiation, and an infra-red sensitive television camera 4 mounted behind the screen 2 so as to monitor the infra-red radiation reflected from the back of the screen 2. The infra-red camera 4 produces a signal representative of the monitored infra-red image (referred to hereinafter as the "monit red image") which is output to an image pr cessor 5

which determines the screen co-ordinates of any point at which the screen is touched in a manner described below.

Without an object touching the screen 2, the reflected infra-red radiation picked up by the camera 4 will be the ambient background radiation reflected from the screen 2 as a whole. This "background image" is stored in the image processor and continually compared with the monitored image.

For much of the time the monitored image will correspond exactly with the background image. However, when the screen is touched (on the opposite side to the image projector 1, etc), using a finger or other suitable object, a local infra-red highlight will be produced due to the energy reflected from the finger/object touching the screen. This highlight will be picked up by the infra-red television camera 3 along with the background radiation. The monitored image containing the highlight is then processed by the image processor to obtain the screen co-ordinates of the point of contact of the touching finger/object (or objects).

The components of the image processor 5 are schematically illustrated in the block diagram of Figure 2. The individual components are standard components and thus will not be described in detail. The monitored image signal output from the infra-red camera 4 is first passed to an arithmetic frame grabber 6 (model number SMT303 supplied by Kane Computing of 7 Theatre Court, London Road, Northwich, Cheshire CW9 5HB). The arithmetic frame grabber essentially comprises a frame grabber module 6a, a background frame store 6b (in which the "background image" is stored as mentioned above), and a subtractor 6c. The frame grabber 6a outputs a signal to both the subtractor 6c and the background frame store 6b, which itself outputs a signal to the subtractor 6c. The subtractor 6c substracts the background image from the monitored image (which will include any infra-red highlight resulting from touching of the screen) and the resultant signal is input to a threshold detector 7 (SMT309 Run Length Enc der supplied by Kane Computing).

The output signal from the threshold detector is input to a digital video interface 8 (model SMT308 supplied by Kane Computing) which functions as a cluster analysis circuit. The digital video interface performs region of interest calculations and outputs both the x and y screen co-ordinates of any local infra-red highlight in the monitored image and also the x and y widths of each highlight.

It will thus be seen that with the described system, incorporating conventional image processing components and techniques, it is possible to determine both the location and size of the point of contact of an object with the screen 2 and to discriminate multiple points of contact.

If desired, the signal output from the digital video interface 8 can be further processed to eliminate components of the signal corresponding to contacts below a minimum size (thereby ensuring that the infra-red highlight is a result of a positive contact with the screen by an object of a given order of size) and/or to eliminate signal components corresponding to infra-red highlights above a pre-determined size in order to disregard incidental contacts such as, for example, a hand being placed on the screen.

The signal output from the image processor can then be passed to the system c.p.u. (not illustrated), which controls the image projected onto the screen, and which can convert the known location of the or each point of touch contact with the screen into appropriate input data.

The system requires little calibration and drift should not be a problem. However, if necessary the stored background image can be updated to take account of any changes in the background radiation, for instance due to ageing of the infra-red source.

It will be appreciated that the described system will respond to a variety of objects used to touch the screen, including fingers (gloved or otherwise) and other forms of stylus.

It will also be understood by the appropriately skilled pers n, that the details of the image processor and image processing method may vary. The

image pr cessor described above is assembled using conventional components but it will be appreciated that other image processing methods and hardware may be used.

In addition, it will be appreciated that the details of the infra-red source, the image projector and the infra-red detector, (i.e. the television camera), could be varied. For instance, the image projector could also function as the infra-red radiation source so that the dedicated floodlight 3 is not required. Also, resolution could be increased by using more than one infra-red detector (eg camera).

Moreover, it will be appreciated that the method of determining the point of contact of an object with a screen in accordance with the present invention is not limited in application to back projection systems, or even to visual display systems.

CLAIMS

1. A method for determining the location of the or each point of contact of one or more objects with a first side of an at least partially transparent screen, the method comprising:

(i) illuminating the opposite side of the screen to said first side with radiation;

(ii) monitoring the radiation reflected from the screen and from any object placed in contact with said first side of the screen and producing a signal representative of the monitored image; and

(iii) processing said monitored image signal to determine the screen co-ordinates of the or each point of contact of an object with the screen.

2. A method according to claim 1, wherein the processing step (iii) includes the step of subtracting a representation of the background radiation reflected by the screen from the signal representative of the monitored image to derive a signal representative of localised highlights resulting from contact of the or each object with the screen.

3. A method according to claim 2, wherein the processing step (iii) further includes the step of thresholding the signal representative of detected highlights.

4. A method according to claim 3, wherein the processing step (iii) further includes performing region of interest calculations to determine both the screen co-ordinates and size of the or each point of contact of an object with the screen, and to discriminate between multiple points of contact.

5. A method according to any preceding claim, wherein said screen is part of a visual display system and said method forms part of a method for inputting data to the systems processor in resp nse to touching said screen, the data input

to the system processor being dependent on the location of the or each point at which the screen is touched.

6. A method according to claim 5, wherein the screen is a back projection diffusing screen.

7. A method according to any preceding claim, wherein the screen is illuminated with infra-red radiation.

8. A system for determining the point of contact of an object with a first side of an at least partially transparent screen, the system comprising a radiation source for illuminating the opposite side of the screen to said first side, at least one radiation detecting means for monitoring the radiation reflected from the screen and from any object placed in contact with said first side of the screen, and for producing a signal representative of the monitored image, and signal processing means for processing the signal representative of the monitored image to determine the screen co-ordinates of the or each point of contact of an object with the screen.

9. A system according to claim 8, wherein the signal processor is an image processor which stores a background image of the background radiation reflected from the screen and subtracts this from the monitored image to produce a signal representative of monitored radiation highlights of reflected radiation from the or each object placed in contact with the screen.

10. A system according to claim 9, wherein the image processor includes thresholding circuitry.

11. A system according to claim 10, wherein the image process r includes cluster analysis circuitry which receives a signal from the thresholding circuitry

and which produces a signal representative of the screen co-ordinates of the or each point of contact of an object with the screen.

12. A system according to claim 11, wherein the cluster analysis circuitry is adapted to determine the size of the or each point of contact of an object with the screen.

13. A system according to claim 11 or 12, wherein the signal output from the cluster analysis circuitry is input to further processing means which eliminates from the signal components representative of points of contact below a minimum size.

14. A system according to any one of claims 11 to 13, wherein the signal output from the cluster analysis circuitry is input to further processing means which eliminates from the signal components representative of points of contact above a pre-determined maximum size.

15. A system according to any one of claims 8 to 14, wherein the system is adapted for use in conjunction with a screen of a visual display system.

16. A system according to claim 15, wherein the system is adapted for use in conjunction with a diffusion back projection screen.

17. A visual display system, comprising a diffusion back projection screen, and a system for determining the screen co-ordinates of the or each point of contact of an object with the screen according to any one of claims 8 to 16.

18. A visual display system according to claim 16, wherein the system includes an image projector which also functions as the radiation source.

19. A visual display system according to any one of claims 8 to 18, wherein the radiation source is a source of infra-red radiation.

20. A method for determining the location of a point of contact of an object with a first side of an at least partially transparent screen, substantially as hereinbefore described, with reference to the accompanying drawings.

21. A system for determining the point of contact of an object with a first side of an at least partially transparent screen, substantially as hereinbefore described, with reference to the accompanying drawings.

22. A visual display system, substantially as hereinbefore described, with reference to the accompanying drawings.

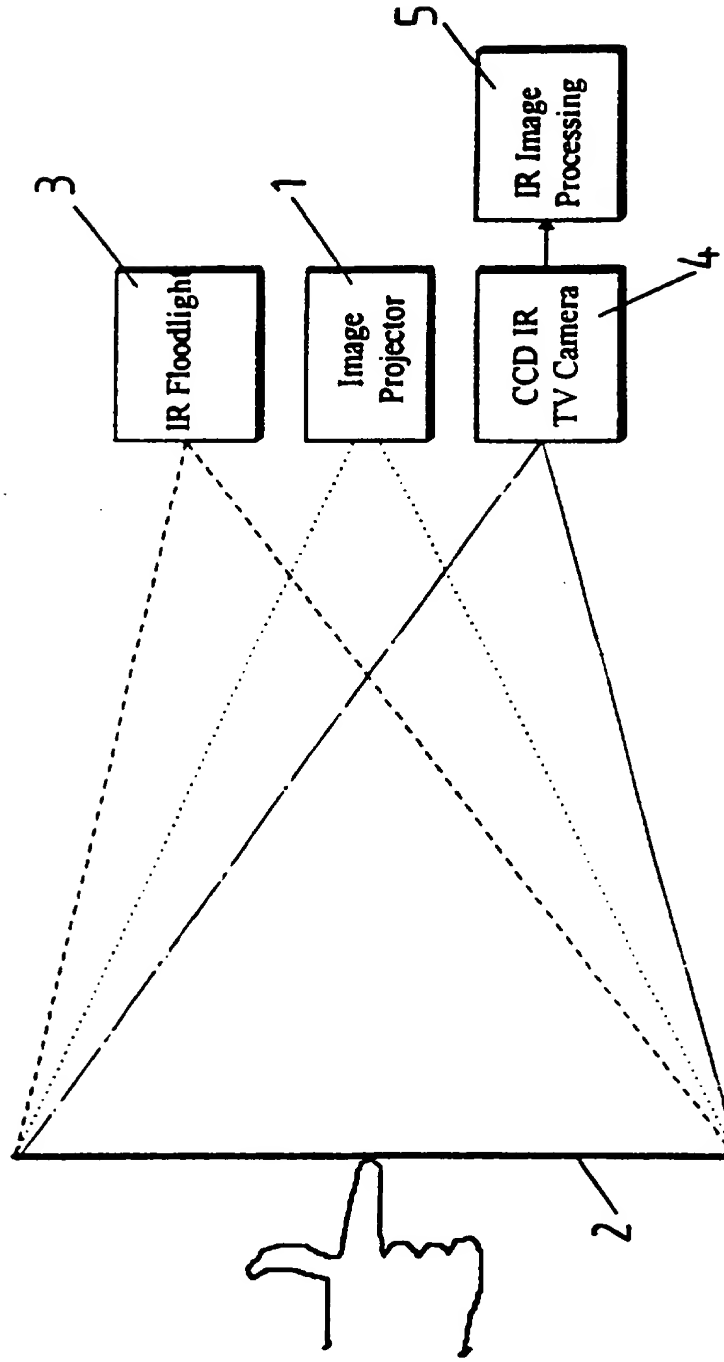
3
1
5
IR Image Processing
IR Floodlight
Image Projector
CCD IR TV Camera
4
2

FIG. 1

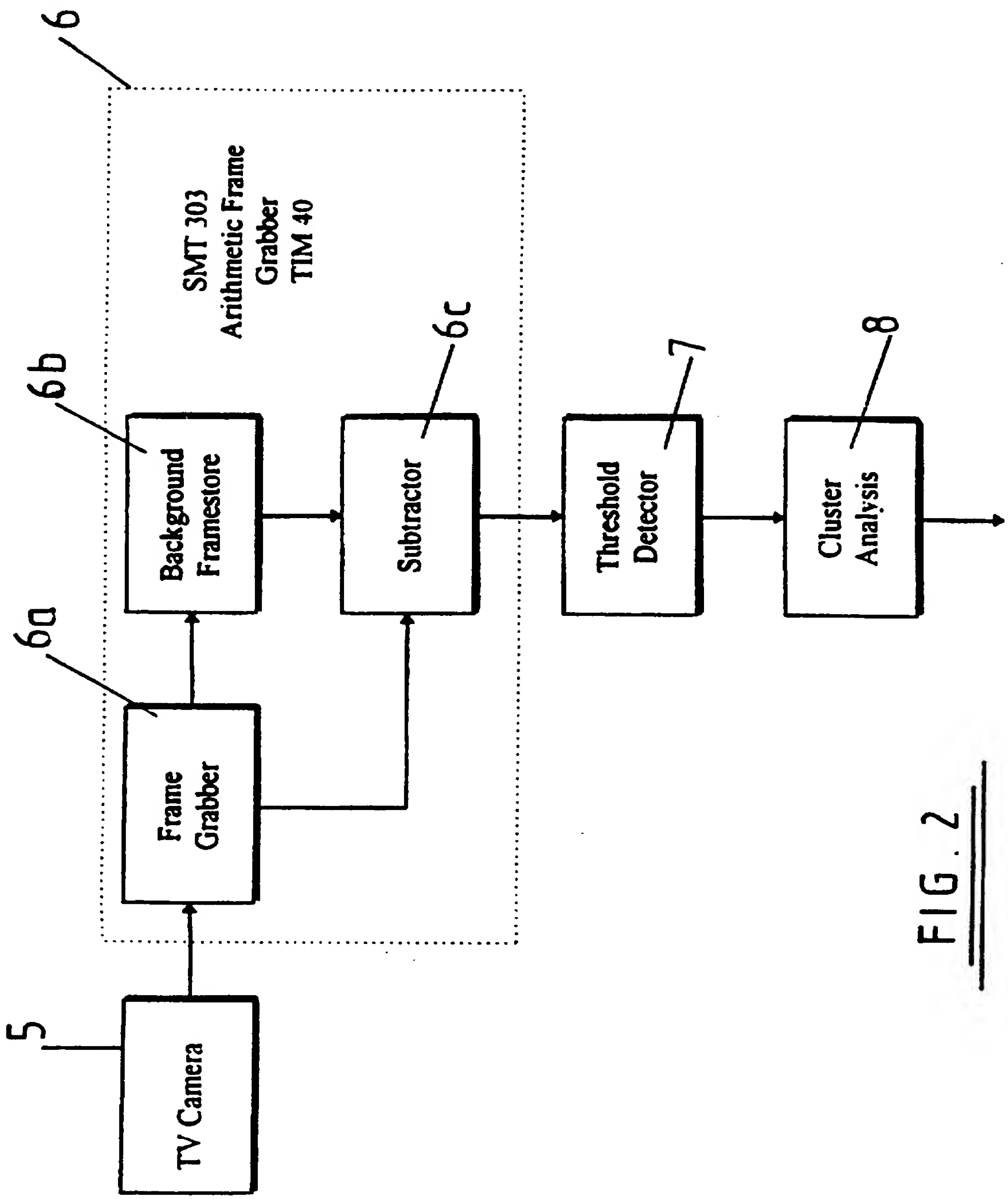
6
SMT 303
Arithmetic Frame
Grabber
TIM 40
6b
6c
7
8
Background
Framestore
Subtractor
Threshold
Detector
Cluster
Analysis
6a
Frame
Grabber
5
TV Camera

FIG. 2

INTERNATIONAL SEARCH REPORT

Inter ·onal Application No
PC /GB 97/00006

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G06K11/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 561 017 A (GREENE RICHARD) 24 December 1985 see column 1, line 24 - column 2, line 9 see column 3, line 1 - line 24 see column 10, line 29 - line 55; figure 4 ---	1-22
X	DE 39 32 508 A (POFA TECHNOLOGY CORP) 4 April 1991 see column 1, line 49 - column 2, line 12; figure 1 see column 3, line 1 - line 10 see column 6, line 61 - column 7, line 1 --- -/--	1,5-8, 15-17, 19-22

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
18 April 1997	13.05.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Nygren, P

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ICASSP '82 PROCEEDINGS, vol. 7, no. 2, May 1982, PARIS, FR, pages 818-820, XP002029733 MEHTA ET AL: "FEATURE EXTRACTION AS A TOOL FOR COMPUTER INPUT" see the whole document ---	1-22
A	EP 0 613 079 A (ZELTRON SPA) 31 August 1994 see column 2, line 28 - line 41 see column 3, line 23 - line 39 see column 4, line 10 - line 35; figure 4 -----	1-22

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 97/00006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4561017 A	24-12-85	NONE	
DE 3932508 A	04-04-91	NONE	
EP 0613079 A	31-08-94	IT PN930012 A	23-08-94